USE OF RAINWATER OPTIMALISASI AND SYSTEM FOR SURFACE FLOW HA

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USE OF RAIN WATER OPTIMIZNG AND SYSTEM FOR SURFACE FLOW HARVESTING BOOST RICE PRODUCTION IN DRY LAND

Sosiawan Hendri

SUMMARY

Dry land is one land resources which have great potential for agricultural development, good crops, horticulture, and plantation. Facts prove that the increase in food production, especially rice, although theoretically possible, but practically it is not easy, because the potential of existing resources such as land is very dry require a lot of input. One of them is the availability of water according to space and time.

During this understanding of the management of dry land is more focused on efforts to increase the productivity of land that is always associated with the addition of fertilizer, erosion prevention, cultivation system without touching aspects of climate and water resources, although both these factors have real impact on improving productivity of dry land for agricultural development. Hydro-klimatik characteristic of dry land is often a constraint in agricultural development can disiasati by: utilizing rainfall as productive as possible with the existing plan and the planting pattern of appropriate planting and use of rain water that falls through the harvesting of surface flow such as by dams and trenches embung . Aspects of planning and the planting pattern of planting can reduce the risk of losing the results. Via the utilization of rainwater harvesting systems can accommodate the flow of surface and rain water can be used to supply water needs for crops during planting season after the rainy season which indirectly increase the cropping index on dry land cultivated for agriculture. Optimization of harvesting rain water and surface streams to increase the production of dry rice will dilahan more effective when combined with climate forecasts that give you an idea when the rainy season and the season ditahun events to come..

Keywords: dry land, planting pattern, time of planting, harvesting rain

INTRODUCTION

According to a study by the National Land Agency, since the two last decades the island of Java which is believed to be one of Indonesia's rice has been experiencing over the function of agricultural land (most of which are paddy field), a residential and industrial areas is very significant in large quantities to reach 81,176 hectares. Assuming population growth rate of 1.6% and industrial sector by 20% per year, shrinking agricultural land on the island of Java in the future become a serious threat to the availability of rice both regionally and nationally. Similarly, that will happen in other areas in Indonesia, especially in centers such as the rice production of Bali and Lombok. Slightly different from Sumatra and other islands, although the growth of food demand also continued to increase in line with population growth, but the speed is much slower than Java. Thus, in addition to rice intensification program of land already dilakasanakan, no wiser choice for the government to conduct a more serious handling of efforts to increase rice production, especially in dry land through the extension program. Dry land is one land resources which have great potential for agricultural development, good crops, horticulture, and plantation. The width is 19.72 million ha of dryland lowland wet climates and 2.74 million ha of dry climates with the potential for food crops (Hidayat, A., et al, 2005) During this understanding for handling dry land cultivation is more focused on technological innovation related to agricultural cultivation, soil fertility improvement, soil conservation are often not disinergiskan with water and climatic factors and institutional (social economy) in terms of management. Although the role of the climatic factors and water in dry land management, especially for increasing rice production is very significant, because in general, dryland farming in Indonesia is rainfed agriculture. Facts prove that the increase in food production, especially rice, although theoretically possible, but practically it is not easy, because the potential of existing resources such as land is very dry require a lot of input. One of them is the availability of water according to space and time. Pewilayahan mapping results of the national rainfall 1:1000 scale of 000 that carried Central Agro-climate and Hydrology Research, shows that the potential expansion of agricultural area is still very wide open when the spatial and temporal distribution of water can be maintained at its optimum (Balit Climate., 2004). This paper discusses the handling of dry land from the aspect of climate sunberdaya especially optimization of rainwater harvesting systems and surface streams as an effort to increase rice production in dry land.

DRY LAND CHARACTERISTICS HYDROCLIMATE

In Indonesia, the availability of water seems abundant in the rainy season period, and instead of water scarcity in the dry season period. In the period of the rainy season there is excess water that can not optimally utilized and often cause flooding. By contrast, in the dry season water scarcity problems are common, especially in food production centers such as the islands of Java and Bali with the ever-increasing amount of good: the intensity, frequency, duration and area. Dryland regions with good water availability fluctuates according to the (spatially) and time (temporally) with high erosion rate which even exceeds the threshold limit is one main target in improving the agricultural area. The length of the period of water stress is often an obstacle in the utilization of dry land. Profile climatological rainfall dry land is characterized by annual rainfall is relatively high but accumulated during the rainy season (November-April). As for the period from May to October rainfall is relatively low, so the risk of crop failure is very high. Picture of extreme climatic resources of dry land are generally mirrored by the amount of rainfall is relatively low (<1000 mm) with a duration of rainfall distribution is very short and concentrated in 2 - 3 months in each year and on the other side is really evapotranspirasi drain the water needs of plants (Fig. 1.). Seen that in normal conditions, the period of rainfall l above evapotranspirasi occurs only during 3 months (December, January and February). Meanwhile, in October until early November that the water deficit is very large in more than a month. This condition will cause the plants experience water stress, and if it happens at a critical period, there will be a decrease in a very big result. The problem is more complicated and complex, if at the same place which led to a climate deviations decrease the amount of rainfall. The length of the period of water stress is often considered an obstacle in the utilization of dry land. And if at that critical moment the plant water needs are met, is believed to increase production because of easy access to music during the drought was the optimum solar radiation in the supply process of photosynthesis. Dryland hydrologic characteristics according Irianto, G., et al. (2001) is generally characterized by high surface flow, especially in the months with high rainfall. Various efforts to use surface flow in addition to irrigation in the dry season through water conservation is a percentage chance of increasing the growth rate of irrigated area. Figure 1. Balance of climate (rain vs. evapotranspirasi) monthly dry land in West Java.

OPTIMIZING THE USE OF RAIN WATER

Optimizing the use of rain water has a temporal and spatial significance for the cultivation of food crops, especially rice on dry land. Temporal meaning means how to use climate resources (rain) as optimal as possible for agricultural cultivation in dry land with the pattern of planning and proper planting time, so avoid the risk of loss results from water stress. Efforts that can be done is by analyzing Agro-climate and soil associated with plants, so be more applicable information to support planning and the growing season reduce the risk of drought (water stress). Meaning more metonjolkan spatial aspects of how the management contribution of excess rain water during the rainy season can be accommodated can be used to increase the acreage in the dry season. Efforts that can be done is to create either water bin rorak, embung, or drafts ditch.

Application of Agro-climate analysis in the growing season planning to reduce the risk of losing the effect of water stress have been carried out by Balitklimat good for crops, horticulture and plant tanhunan. Growing season predictions made by the plant water balance simulation using daily climate data series for 10 years. Crop water balance simulation using a model developed by FAO in the Bulletin of Irrigation No. 56 (FAO, 1988) which has been modified into a Bulletin Agro-climate (1999) and has been refined and validated to the WARM model version 1.0 (Water and Agroclimate Resource Management) Determination of the planting period is based on the analysis of ETR / ETM (real evapotranspirasi / evapotranspirasi maximum) and relative loss results. ETR / ETM is an index value that states the adequacy of water plants. Plants grow well say if the ratio ETR / ETM near 1, while the plant is the critical limit 0.65. Loss of the relative value is calculated based on the relative water deficit stress multiplied by the coefficient of each phase of the plants whose value is less than 20% (Allen et al., 1998). Potential decrease in results is due not tercukupinya crop water needs during growth. The bigger the deficit experienced by plants, the greater the percentage loss results. To determine when the proper planting time, then the scenario is made on every 15th day of planting, which is dated January 1, January 15, January 30 and so on until December 21. Further calculated the ratio ETR / ETM and the percentage loss in each phase of the plant and each date of planting. When planting is determined by calculating the ratio ETR / ETM> 0.8 and the percentage loss of <20%, especially in the critical phase of the plant. By knowing the critical periods of crop, and the potential water resources, it is expected to create an optimal combination of water use and settings using the earnings period. Thus, the supply will be obtained assurance of quality results in large numbers on an ongoing basis. From fluctuations ETR / ETM and the percentage loss results have been obtained based on the date runut actual planting, can be planted evaluate whether the choice was either done or not. Figure 2 is one example of the analysis results of percentage loss in grain Tamanbogo, Lampung with taking the year 2004 as the year scenario simulations, the best planting date is December 27, 2004 with the percentage of ETR / ETM more than 0.8 respectively in an initial phase, vegetative , flowering, formation of cooking results and is 100%, 100%, 100%, 85%, and 5%. loss of 8% comes from the vegetative phase. With reference to the simulation results, carried out a combination of planting pattern of the safest escape from the risk of drought. Next to the condition that the loss occurred in the dry season, when rice cultivation still be necessary provision supplementary irrigation with dose and time in accordance with the needs of plants. Figure 2. Percentage loss of rice in Tamanbogo at various planting dates. RAIN HARVEST SYSTEM AND RUN OFF (Irianto, G., et al, 2005)

Rain harvesting systems and surface streams are alternative technologies that can serve to reduce flooding in the rainy season and provide a source of irrigation water during the dry season to expand the planting area, increasing the intensity of planting, production, productivity and quality of crops. Rain water that exceeds the capacity watershed during the rainy season would harm they may cause flooding that affects agricultural land and settlements. On the other hand during the dry season many agricultural areas experiencing drought, require irrigation for agriculture is not declining. Rain harvesting efforts can be implemented without the need to sacrifice their land for the major such as settlements and agricultural land. Rorak or structures such as wells and dams catchment parit.hanya utilize existing available space without disturbing the primary function of the land. Rorak is a kind of shallow wells are made in such a dry land fields or gardens, while the absorption wells are generally made in the settlement area. Embung is the means of water reservoirs in the rainy season. Utilization embung usually only for the purposes of irrigation land each peasant farming and other purposes. Reservoir that can hold water between 5 thousand to 10 thousand m3 has now been developed in Central Java in the Pati and Blora. Embung development more difficult because the scarcity of land suitable for yag topographical constraints and the impermeable layer that can hold water. Reservoir is embung larger scale and can contribute to a variety of other functions, as power plants and fisheries. Placements are usually somewhat dihulu reservoirs to the water to users only by gravity dihilir. Besides dihulu water is more likely to relatively uncontaminated compared to downstream. Because it requires a larger land increasingly difficult to find suitable land for the construction of reservoirs, especially the regions rather kehulu Dam trench (channel reservoir) just using the path of existing drainage, so not much to reduce agricultural land. Water is also allowed to permeate so as to increase the basic flow (base flow) that can be utilized by the plants and fill in the lower wells. Considerations used in determining the impact position of the aspects of the trench is capacity and cost, so choose the most narrow point dihilir relatively flat line. Everything can be calculated if the data input from the rain which is good enough. (Amien, L.I., et al, 2005). Technology other than the trench dams can increase the expansion of planting area, can also be used as a supplemental source of irrigation water on dry land as well as for debit menerunkan peak in the rainy season. Implementation of development ditch dams Some of the advantages to be gained by making the trench dams are: (1) can quantitatively reduce the volume of surface flow and peak flow and increased base flow during the dry season, (2) increase the availability of water to reduce the risk of drought, especially in the dry season, extending the growing season and creating dry land farming diversification, and can reduce the risk of flooding, (3) improve productivity of dry land through the optimum combination of water resources with the type and amount of cultivated commodity. Practically in the field of channel reservoirs in cascade can be seen on the terrace rice field which regularly accommodate excess water from the upper terrace, store and distribute if diperlakan in the dry season, when diatus, or when excess (limpas) during the rainy season. Another benefit of the development of reservoirs in cascade channel is the increase of ground water reserves in response to increased volume and duration of flow to the side (seepage) and percolation into the soil (water percolation). The basic concept of the hydrological network utilization for the development of reservoir channel are presented in Figure 3. Figure 3. The basic concept of hydrology network utilization through the development of reservoir channel.

Experience has shown that the dam trench application development in Yogyakarta Special Region (DIY) Central Java (Semarang); West Java (Puncak-Bogor) (Fig. 4) has increased land productivity and reduce peak flow and improved watershed response so as to eliminate the risk of flooding. Sub-watershed in Bunder, Gunungkidul district, DIY, dam application can change the moat has a cultivated plant species from dry land into paddy rice fields, and can extend the growing season for 4 months. Another influence of dam construction in the trenches of DIY story on several parameters of hydrology, agronomy, social and economic are presented in Table 1, while application-story trench dams in Central Java have been able to reduce the peak flow between 45-90% and improved response time 12-60 minutes DAS .

Figure 4: Prototype DIY trench dams (a), Central Java (b), and West Java (c)

Table 1. The influence of dam construction trench in DIY story of hydrological parameters, agronomic, economic and social
Characteristics of the effect on several parameters Characteristic
Impact on several parameters- Making 3 draftsman trench with a capacity of each patch 80, 100 and 150 m3 in the main river channel (order to-1) HydrologyHydrology

- Reducing the peak flow by 25%

- Hold around 19 m3/th sediments (60 tons of dry soil) in the dam to-1, and 90 m3/th (141 tons of dry soil) in the trench to the dam-- AplThe application of irrigation water delivery to the rice crop area (area: 3000 m2) Agronomy

Agronomy

- Production of rice increased from 1 ton / ha before the dam was built trenches, to be 2-2.5 tons / ha after a dam trench

- There is an increased intensity of rice planting 1 times / year to 2 times / year - Cost of making the dam the ditch around Rp. 3.000.0000, Economic

- Internal Rate Return (IRR) is of about 40%

- Return on capital (break event point) will occur in year 4 - Participation of farmers is very well reach more than 50% of total cost (material and labor) SocialSocial- Participation of farmers groups from the planning, implementation to maintenance of the dam construction trench Source: The research Balitklimat and CIRAD (2001-2003)

Results of research on Jogjogan village, Cisarua district, Bogor regency, West Java trench showed that the dam was built with a capacity of 100 m3 to increase the planting area of 4 ha of water sufficient for the existing plants in the dry season, so that agricultural land in the research area can be planted throughout the year, with the increase in acreage 4.11 hectares in the dry season. Dam trench can also reduce the surface flow rate for Sub-Basin 9% Cipucung. Balitklimat research results indicate that the volume of 250 m3 trench dams in the dry season can accommodate and reduce runoff by 45% of the total flow, whereas in the rainy season can reduce the peak flow of the river flow by 17%. IRRIGATION SUPPLEMENTARY
Without the application of supplemental irrigation technology and water saving technology, conventional farming systems in dryland sensitive to both drought flogging a short period in the rainy season, especially during the dry season. With the use of supplemental irrigation technology, the planting season (for seasonal crops) in most parts of Indonesia is not

limited to the rainy season, but could be extended until the middle of the dry season. This is possible because about 83% of Indonesia has an annual rainfall> 2000 mm. The number of dry days in a row during the planting season is a useful indicator in determining whether the plants will experience water stress or not. Period without rain for 7 days or more can cause disturbance of plants, especially in the early growth of the plant where the roots of plants is still limited to a few centimeter layer of topsoil. Gogo rice crop will be very miserable if the experience of ground water stress (soil water content retained about 50% of field capacity water content) for 10 consecutive days in the early phase of growth or flowering. (Agus, F., 2005). Thus the paradigm of development in upland rice which rely solely on rain water change should begin with providing water-saving irrigation through supplementary irrigation technology. The amount of irrigation water given set according to crop needs, soil holding water capacity, as well as irrigation facilities are available. At the critical phase of the plant, then the amount of water given greater. For rice critical phase occurs at the flowering stage at the age of about 60 days. Figure 5 is an illustration of when and how much irrigation water should be given to rainfed rice in the region Gunungkidul, Yogyakarta. The amount and timing of irrigation water is calculated from the simulation results of water balance of plants. Calculation of the evapo-transpiration consider that occurred during the plant growth cycle 1, so the amount and timing of irrigation water which can be known to every phase of plant growth. The model also provides an alternative reduction of the amount of irrigation water given to the consequences of any reduction in the growth phase. Thus one might expect the amount of irrigation can still ditoleransikan by plants with the risk of loss of production above the minimum threshold. In order to facilitate the implementation, the interval of irrigation water provision should be made to match the period with the hose water balance, and phase of plant growth. Making supplementary irrigation can be done on dry land by utilizing the available water resources as efficiently as possible. Basin areas in the watershed could be used to build the dam-dam water that can accommodate excess water during the rainy season and then can be used for irrigation during water shortage / drought, allowing the diversification of farming done. The addition of irrigation water can not stand alone and will only be effective if accompanied by adequate fertilization and balanced, the use of high yielding varieties, and control of pests and plant diseases. Figure 5. The amount and timing of irrigation rainfed rice planted on 11 November in Gunungkidul, Yogyakarta.

Increasingly important role of irrigation in agricultural areas that are sensitive to drought. Irrigation systems are applied today are generally still include traditional distribution and use of water, but less attention to the balance between the amount of water provided and water needs of plants. Non-technical irrigation systems tend to waste water use, reduce the efficiency of nutrient use, and cause degradation of land due to flooding, especially if the irrigation system is not integrated with the drainage. Modern irrigation systems can be divided into five categories namely a) the water surface; b) sprinkle irrigation; c) micro irrigation (drip = trickle); d) irrigation sub-irrigation; and e) water hybrid (transitions between two or more systems). (Agus, M,, 2005).

Climate forecasting

The concept of planning and the planting pattern with Agro-climate analysis approach above can only be properly applied in the field when they are supported by quantifying the precise characteristics of meteorological and climate forecasting up to date is able to answer whether the current year and the future is a normal year, or a deviation occurs (an anomaly) good climate with abundance of rain (La Nina) or dry years (El Nino). Balitklimat since 2002 have started to develop with the establishment of climate forecasting climate anomalies with the working group monitor the development activities of global and regional climate. In the next year began to be initiated by rainfall prediction using Kalman filter methods. In 2003 Kalman Filter method began to be used to predict monthly rainfall in agricultural R & D climate stations in 7 provinces.

RAINFALL PREDICTION Models used in climate forecasting is the rainfall prediction approaches. One indicator is often used to see the symptoms of climate anomalies are Sea Surface Temperature (SST). Some research indicates that there is a correlation between Nino 3.4 SST with rainfall in Indonesia (McBride and Haylock, 2001 in the Mid-year Report Baliklimat, 2005). Keragamaman SST in Nino 3-4 affects 50% variation of rainfall throughout. Therefore, sea surface temperature (sea surface temperature, SST) is used as a parameter to predict rainfall. Monthly rainfall forecasts are used prior to 2002 were weighted regression analysis between rainfall anomalies and SST anomalies Nino 3.4. The results of these precipitation forecasts have a fairly good accuracy in the wet season and dry season, a better accuracy in rainfall patterns than monsunal equatorial rain patterns and local, not yet able to predict the exceptional rainfall conditions (extreme), and the area has a diversity of in high season (Irianto, et al 2003 in Balitklimat, 2005). Thus, to improve the accuracy of climate forecasts of rainfall, especially the development of methodologies needs to be done by using Kalman filter technique which is the development of methods autoregresi. Results validation Kalman filter (Kalman Filter) for the station Kotabumi, Lampung with a correlation coefficient value of the model (KKM) the highest of 80.8% is the ARMAX model of order 20-20-18-19. While rainfall in June to November 2005 is forecasted to range between 120-190 mm / month with 79.59% of KKM. Peak rainfall occurs in November, and on top of the dry season is June to September rainfall is relatively high forecasted. The nature of rainfall in June-November 2005 in this area ranges from normal to above normal (Fig. 6) Figure 6. Validation and monthly rainfall prediction Kotabumi station, Lampung June - November 2005

The use of local climate indicator for early detection of seasonal changes
Transitional seasons which tend to vary according to space and time needed to detect early, especially for agricultural planning and planting period commodities can be prepared in accordance with the actual climate conditions. Identify changes in the dry season to rainy season or vice versa can be done using penciri season indicators to determine whether the region is in the wet season period (MH), entered the rainy season (Minh), the dry season (MK), and entered the dry season (MMK). Three local penciri indicators used to monitor the development pattern of the seasons and the changes are: air humidity, wind direction, wind speed. Table 2 is an example of the recapitulation of the initial and average length of the season each region (the rain) in Cirebon regency.
Table 2. Beginning and average length of each group Kab season. Cirebon

In addition to the local climate information, the actual development of such indicators of global climate anomalies Sea Surface Temperature (SST), southern oscillation index (SOI), and indian Oceal Dipole (IOD) can be used to describe the climatic conditions in Indonesia. For example, information can be obtained about the actual condition of the Sea Surface Temperature anomalies (Fig. 3) l and predictions until the mid-year 2006 (Table 3). Other information is the prediction of rainfall over Indonesia and Australia are each month are updated IRI can routinely access   Table 3. Opportunities in the region predicted SST Nino 3.4

Source: IRI for climate prediction, last updated 31 Augt 2005   CONCLUSION

1. Characteristics of a relatively extreme climate and tends to dry land fluktuatuf need to be quantified and characterized its potential can be maximally utilized for the development of agriculture 2. The high flow of surface hydrological constraints often become dry land can be used as a source of irrigation during the dry season with rain paemanenan systems and surface streams. 3. Rain harvesting technologies and proven surface flow applicable and promising is the dam pembuutan ditch. 4. Efforts that can be done in a deal with climate characteristics of dry land is fluctuating pattern with planning and proper planting time to avoid the risk of losing the results. 5. Providing additional irrigation (supplementary) with the surface flow is memanfaatan technological options to reduce the risk of drought, increased diversification of farming and increase the productivity of dry land. 6. Climate forecasting holds a very important role in planning and predictive pattern of growing season, because the picture memeberi whether the current year or the year deviation occurs normally. 7. Efforts to optimize the harvesting of rain and surface flow will be effective if supported by climate forecasting.   REFERENCES
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